Factors Associated With Prevalent Hepatitis C: Differences Among Young Adult Injection Drug Users in Lower and Upper Manhattan, New York City

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A B S T R A C T

Objectives. This study examined correlates of prevalent hepatitis C virus (HCV) infection among young adult injection drug users in 2 neighborhoods in New York City.

Methods. Injection drug users aged 18 to 29 years were street recruited from the Lower East Side and Harlem. Participants were interviewed about drug use and sex practices; venipuncture was performed for hepatitis B virus (HBV), HCV, and HIV serologies.

Results. In both sites, testing positive for HCV antibody (anti-HCV) was associated with having injected for more than 3 years. Additionally, HCV infection was positively associated with injecting with someone known to have had hepatitis (but the association was significant only in the Lower East Side) and with sharing cotton (but the association was statistically significant only in Harlem). Being in drug treatment and older than 24 years were associated with HCV in the Lower East Side but not in Harlem. Receiving money for sex was associated with anti-HCV positivity in Harlem but not in the Lower East Side.

Conclusions. Several differences in factors associated with prevalent HCV infection existed among 2 populations of young injection drug users from the same city. Indirect transmission of HCV may occur. (*Am J Public Health.* 2001; 91:23–30)

Injection drug users are at high risk for hepatitis C virus (HCV) infection.[1–3] Although geographic variation exists, HCV rates among injection drug users are often higher than 60% and in many cities approach 90%.[4–7] A recent study in Baltimore, Md, showed that HCV infection rates were 60% among injection drug users with less than 2 years' experience with injection.[8] If transmission is indeed this rapid (and efficient), then more aggressive public health measures are needed to reduce transmission in this vulnerable population. Aggressive prevention of HCV also is important because therapy for HCV is costly and, so far in the United States, usually not offered to active injection drug users.[2,3] Unfortunately, some studies suggest that high HCV infection incidence among injection drug users is the result of the already high proportion with chronic infection (approaching 85% of those infected), providing a huge reservoir from which transmission can occur.[2] High HCV prevalence among young injectors from different locations adds additional urgency to the call for more intense and sustained preventive measures.

The purpose of this study was to examine rates and correlates of HCV infection among young adult (mostly recent onset) injection drug users in 2 very different neighborhoods in New York City: the Lower East Side and Harlem. We examined factors associated with prevalent HCV infection from baseline interviews conducted from 1997 through 1998 among injection drug users aged 18 to 29 years in these 2 neighborhoods.

Methods

Study Population

The study population was recruited (during 1997–1998) as part of a cohort study from 2 of 6 Centers for Disease Control and Prevention sites for the Collaborative Injection Drug User Study II. The 2 New York City sites were located in the Lower East Side (conducted by Beth Israel Medical Center and National Development and Research Institutes) and in Central and East Harlem (conducted by Center for Urban Epidemiologic Studies, New York Academy of Medicine). Eligibility criteria and the core questionnaire were the same for all sites; recruitment methods may have varied slightly by sites, but for all sites, street recruitment (not recruitment from drug treatment programs) was the focus.

Eligibility

To be eligible for the study, participants needed 1 or more of the following criteria: to

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report injection drug use during the previous 6 months, to have injected for less than 3 years, or to be between 18 and 29 years of age. Potential participants were asked a series of questions unrelated to the eligibility criteria (e.g., "Do you have siblings?"). The eligibility criteria were not advertised because we thought that knowledge of these criteria might lead persons to falsely represent their injection practices and age in order to enter the study. Because few injection drug users older than 29 had injected for less than 3 years, for this analysis we included only persons between 18 and 29 years of age.

Sites

The Harlem study, known as Harlem Outreach Prevention and Education, was conducted from a building in Central Harlem, New York City. Recruitment took place in both Central Harlem (predominantly African American) and East Harlem (predominantly Latino).

For the Lower East Side, the study was conducted in a research storefront office located in that neighborhood. The research storefront has been in continuous operation since 1989 and is well known among drug users in the community. The Lower East Side is an ethnically diverse neighborhood with a large transient population of young White persons from nearby suburbs and the rest of the United States.

Recruitment

Community-based outreach techniques were used to recruit young adult injection drug users. First, ethnographic techniques were used to map Central and East Harlem and the Lower East Side to determine specific areas where young injection drug users congregated. Recruiters were then sent to these areas, where they approached young persons, engaged them in conversation, formally assessed eligibility by asking structured questions, and asked persons who were eligible to participate in the study. Those who agreed to participate in the study were escorted to the study office to receive information about the study and provide informed consent. They also were given a small monetary incentive ($25) after completion of an interview.

Data Collection

At baseline, eligible and consenting participants underwent standardized face-to-face interviews conducted by trained interviewers in private rooms as well as venipuncture. Participants received pretest counseling about the serologic tests (HIV, hepatitis B virus [HBV], and HCV). Participants were given risk reduction counseling and referral information for services such as drug treatment and social services. To minimize bias, however, this was not done until after the interview was completed.

All participants were offered test results and posttest counseling. Participants with any positive test results were offered referrals for follow-up medical evaluation. Those with negative HBV test results were offered referral for hepatitis B vaccination. The study received institutional review board approval from Beth Israel Medical Center, the National Development and Research Institutes, the New York City Department of Health, and the Centers for Disease Control and Prevention.

Interviews

The interview included questions on sociodemographics, injecting behaviors, sexual behaviors, and quasi networks. Drug use questions included age at which the participant first injected drugs and the age of the person(s) who initiated the participant into injection drug use. Other drug use questions focused on the 6 months prior to the interview and included frequency of injecting, type(s) of drug injected, use of direct sharing (using a syringe after someone else) and indirect sharing (using cotton, rinse water, or a cooker after someone else), and use of syringe exchange or drug treatment. Sex practice variables, including number of sex partners, sexual preference, exchange of sex for money or drugs, and use of condoms (separately for steady and nonsteady partners), were ascertained for 6 months preceding the interview. Finally, persons were asked whether they had ever been raped, been in prison, or injected with someone known to have had hepatitis (quasi network).

Laboratory Analysis

Serum from blood specimens was analyzed for HIV-1 antibodies by standard techniques at local laboratories. Specimens repeatedly reactive on enzyme-linked immunosorbent assay were confirmed with Western blot.

Blood specimens were sent to the Centers for Disease Control and Prevention to test serologic markers for HBV and HCV infection. Samples were tested for antibody to HCV (Abbott HCV EIA 2.0, Abbott Laboratories, Chicago, Ill). A sample of 100 specimens repeatedly reactive for HCV based on enzyme immunoassay received supplemental testing, and results for all were found to be positive. Because of the high positive predictive value of repeat reactive enzyme immunoassay testing in this population, no further supplemental HCV testing was performed. Therefore, persons with positive repeat reactive enzyme immunoassay test results were considered to have evidence of past HCV infection.

Samples were tested for antibody to HBV core antigen (anti-HBc) (CORAB, Abbott Laboratories, Chicago, Ill). Samples testing positive for anti-HBc were then tested for hepatitis B surface antigen (HBsAg) (AUSAB EIA, Abbott Laboratories), and if the results were negative, the samples were tested for antibody to HBsAg (anti-HBs) (AUSTRIA II-125, Abbott Laboratories). Because of this sequence of testing, many serum samples of blood did not contain sufficient amounts for the anti-HBs testing. Therefore, in the analysis, only data on anti-HBc and HBsAg are presented. Persons with positive test results for either anti-HBc alone or for anti-HBc in combination with HBsAg were considered to have evidence of HBV infection.

Statistical Analysis

Initial frequency comparisons were made between the 2 sites to examine the proportion of subjects by sociodemographic characteristics; initiation of injection drug use; gender; whether participants had ever been raped or been in prison; quasi network; HCV, HBV, and HIV status; and drug use behaviors and sexual behaviors in the past 6 months.

The prevalence of HCV infection by number of years of injection drug use was calculated separately for each site, and Mantel-Haenszel χ^2 tests for linear trend were used to determine whether HCV infection was associated with the number of years of injection drug use.

Within each site, contingency tables with prevalence odds ratios (ORs) and 95% confidence intervals (CIs) were used to study unadjusted associations between different risk factors and HCV infection. Because of the great differences between Harlem and the Lower East Side, these associations were examined separately for each site.

To study adjusted associations between risk factors and HCV infection, we developed multivariate logistic regression models separately for each site in the following manner. All factors found in the univariate analysis for the given site to have prevalence odds ratios that (with 95% confidence intervals) excluded unity were entered into each model. HBV infection was not considered because it is an outcome of the same risky behavior that leads to HCV infection.

Backward stepwise elimination was done with SAS (SAS Institute Inc, Cary, NC) default criteria for removal from the model. For each site-specific analysis, the remaining variables were examined for collinearity (i.e., Pearson correlation coefficient>0.5) within each site. The following pairs of variables were found to be collinear within both sites: (1) use

TABLE 1—Baseline Sociodemographics, Lifetime Events, Network, Behaviors, and Serologic Test Results of Young Injection Drug Users in New York City, by Site of Recruitment

	Lower East Side (n=357)	Harlem (n=200)	*P*
Demographics			
Median age, y	23	26[a]	<.001
Race/ethnicity			
White	78%	13%	
Black	4%	10%	<.001
Hispanic	10%	75%	
Other	8%	2%	
Male	73%	71%	.692
Homeless in past 6 mo	77%	41%	.001
How primarily gets money for living			
Regular job	13%	11%	.576
Recycling, panhandling	24%	3%	<.001
State or federal benefits	6%	21%	<.001
Parent/friend/relative	10%	17%	.027
Selling drugs	14%	21%	.058
Other	33%	27%	.156
High school graduate or general equivalency diploma	59%	44%	.004
Lifetime events			
Ever been raped	15%	9%	.020
Ever been in prison	15%	49%	<.001
Quasi network			
Ever injected with someone known to have had hepatitis	23%	5%	.001
Factors associated with initiation of drug injection			
Initiated by someone >5 y older	21%	41%	.001
Initiated before age of 18 y	47%	24%	.001
Drug use behaviors			
Duration of injection ≤3 y	41%	43%	.676
Used speedball past 6 mo	61%	44%	.001
Used cocaine past 6 mo	69%	39%	.001
Used heroin past 6 mo	98%	96%	.137
Used crack past 6 mo	52%	42%	.010
Shared needle past 6 mo	31%	26%	.208
Injected more than once a week past 6 mo	68%	78%	.005
Shared cotton past 6 mo	50%	37%	.001
Shared cooker past 6 mo	60%	40%	.002
Shared rinse water past 6 mo	43%	29%	.001
Used syringe exchange past 6 mo	82%	58%	.259
In drug treatment past 6 mo	32%	59%	.001
Sexual behaviors past 6 mo			
Received money for sex	11%	14%	.367
Received drugs for sex	6%	9%	.167
Proportion of men who have sex with men	8%	8%	.998
>5 sex partners	18%	14%	.176
Ever used condom with steady sex partner	62%	41%	.001
Ever used condom with nonsteady sex partner	85%	71%	.001
Serologic tests			
No infection	52%	32%	.001
Hepatitis C antibody positive[b]	42%	52%	.031
Hepatitis B virus infection[c]	23%	39%	.001
HIV positive	3%	10%	.001

[a] *t* test (age range each site, 18–29 years, skewness and kurtosis < 2 for each site).
[b] Persons who had positive repeat reactive enzyme immunoassay test results were considered to have evidence of past hepatitis C virus infection.
[c] Persons who had positive test results for antibody to hepatitis B virus core antigen either alone or in combination with hepatitis B surface antigen were considered to have evidence of hepatitis B virus infection.

of cocaine and speedball and (2) sharing of cotton and cooker. Because the literature suggests a strong association of HCV with cocaine injection,[4–6] cocaine was retained in the model, and speedball use was removed. Because sharing of cotton was more strongly associated with HCV infection, it was retained in the model, and cooker was removed. No 2-way interaction was found between any of the variables and HCV infection in these site-specific final models. The final models for each site contained all factors associated with HCV at either site.

We also created a multivariate logistic regression model that combined both sites, entering variables that were significant at either site in bivariate analysis and including site as a variable. All the factors in the final combined model also were significant in the separate site-specific models; no additional variables were found to be significant. The best fitting model showed that 3 variables significantly interacted with site, which suggests that predictors for HCV infection differ by site. For this reason, we present here only the results of the separate site-specific models.

Results

Several significant differences ($P<.05$) were noted between the sample sites (Table 1). In the Lower East Side, the majority of the participants were White (78%) and had experienced homelessness in the past 6 months (77%), and the most common source of income was panhandling (24%). In Harlem, the majority of the participants were Hispanic (75%), fewer than half had been homeless in the past 6 months (41%), and the 2 most common sources of income were state or federal benefits and selling drugs (21% each). One of the largest differences noted between the sites was the proportion reporting ever having been in prison—49% of the participants from Harlem compared with 15% of the persons from the Lower East Side ($P<.001$). The proportion of participants reporting ever having injected drugs with someone known to have had hepatitis was significantly larger ($P=.001$) in the Lower East side than in Harlem (23% vs 5%).

Factors associated with initiation of drug injection indicated that 41% of the participants from Harlem, compared with 21% of the participants from the Lower East Side ($P=.001$), had been initiated by someone at least 5 years older than themselves. In addition to participants in the Lower East Side being significantly younger ($P=.01$) than those from Harlem, 47% of the participants from the Lower East Side began injecting before 18 years of age, compared with 24% of the participants from Harlem ($P=.001$).

In terms of behaviors, a similar proportion of participants from both sites had injected for 3 years or less. However, the use of speedball or cocaine, the sharing of cotton or cookers, and the use of a syringe exchange were more common in the Lower East Side than in Harlem (Table 1). Being in drug treatment was more common in Harlem than in the Lower East Side. In relation to sexual behaviors during the previous 6 months, the only notable difference between the study sites was that a significantly larger proportion of participants from the Lower East Side reported ever using a condom with their steady partner (62%) and nonsteady partners (85%) than did participants from Harlem (41% and 71%, respectively).

Hepatitic C virus was the most common infection—42% of the persons from the Lower East Side and 52% of the persons from Harlem had positive test results for HCV antibody (P=.031). Larger proportions of participants from Harlem, compared with those from the Lower East Side, were infected with HIV and HBV (Table 1).

Because persons could be infected with more than 1 pathogen, we examined the different patterns of infection for each site. No significant differences by site were found in the pattern of infection with multiple pathogens. For both sites, if a participant was infected, infection with HCV alone was the most common pattern (25% in the Lower East Side, 23% in Harlem), followed by infection with both HCV and HBV together (15% in the Lower East Side, 22% in Harlem), and then by infection with HBV alone (6% in the Lower East Side, 13% in Harlem). For both sites, simultaneous infection with all 3 pathogens was uncommon (<6%).

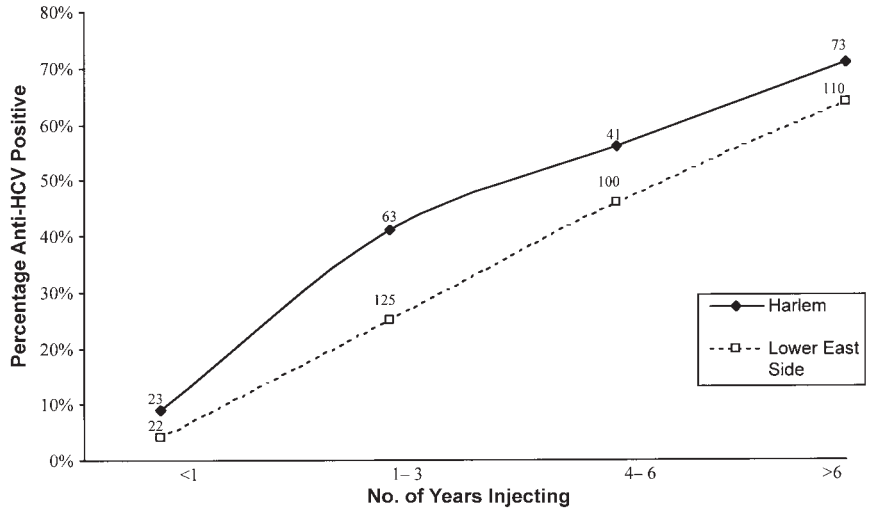
We compared HCV seroprevalence by site with a focus on duration of drug injection (Figure 1). Mantel-Haenszel χ^2 tests for linear trend by duration of injection drug use were highly significant for both sites (P<.001). At each level of duration, the proportion of injection drug users infected was lower in the Lower East Side than in Harlem, but 95% confidence limits overlapped slightly (not shown in figure). By more than 6 years of injecting, 71% of those in Harlem and 64% of those in the Lower East Side were infected with HCV.

Several risk factors were associated with HCV infection for both the Lower East Side and Harlem (Table 2). HCV infection had a significant positive association with injecting for more than 3 years (prevalence ORs=4.35 and 3.98, respectively), having ever been in prison, and having injected cocaine or speedball in the past 6 months. Having evidence of HBV infection also was associated with HCV infection.

We also noted differences by recruitment site in factors associated with HCV infection. For the Lower East Side, HCV seropositivity had significant positive associations (on bivariate analysis) with being older than 24 years, having injected with someone known to have had hepatitis, using syringe exchange in the past 6 months, being in drug treatment in the previous 6 months, receiving drugs for sex in the previous 6 months, and having HIV infection (Table 2). For Harlem, HCV seropositivity had significant positive associations with having initiated injection drug use before 18 years of age; sharing cotton, cooker, or rinse water in the past 6 months; and receiving money for sex.

In multivariate analysis, several factors had similar positive associations with HCV at both sites (although the associations were not always statistically significant at both sites). Injecting for more than 3 years was significantly associated with HCV infection at both sites (Table 3). Injecting with someone known to have had hepatitis was positively associated with HCV infection at both sites, but the confidence intervals for the prevalence odds ratio overlapped 1 in Harlem. Cocaine use in the prior 6 months was statistically associated with HCV infection in Harlem but not in the Lower East Side, although in the Lower East Side a positive association was observed (adjusted OR=1.64, 95% CI=0.94, 2.83). Similarly, sharing cotton was associated with HCV infection in Harlem but not in the Lower East Side, although in the Lower East Side a positive association was observed that did not reach statistical significance (adjusted OR=1.33, 95% CI=0.81, 2.21).

Several factors associated with HCV infection differed by site. In the Lower East Side but not in Harlem, being older than 24 years and being in drug treatment in the past 6 months were associated with HCV. In Harlem but not in the Lower East Side, receiving money for sex in the previous 6 months was positively associated with HCV infection (Table 3).



Note. Numbers on line represent denominator for each point in time. Mantel-Haenszel χ^2 for linear trend, P<.001.

FIGURE 1—Proportion of young injection drug users infected with hepatitis C virus (HCV), by number of years injecting.

Discussion

We found that young adult injection drug users in 2 different neighborhoods within 5 miles of each other in the same city had several factors for HCV infection in common but also showed different risk factors for HCV infection. Although the proportion who recently initiated injection drug use (i.e., 3 years or less) was similar, the 2 samples differed in terms of anti-HCV prevalence, demographics, and some behaviors associated with HCV infection. Defining and understanding the reasons for these differences may lead to better tailoring of prevention programs and treatment services for young injection drug users in these neighborhoods.

Our data reflect demographically different drug-using populations in the 2 neighborhoods. However, despite the demographic differences, the most common drug injected for both sites (heroin) was the same. The demographic differences by site may be explained by the neighborhood characteristics.

The Lower East Side has attracted young persons from throughout the United States who might spend only several months in New York City, especially in the summer. Although we did not ask directly, our data provide some clues

TABLE 2—Risks for Hepatitis C Virus (HCV) Infection for Young Injection Drug Users in New York City, by Site of Recruitment[a]

	Lower East Side (n = 357)				Harlem (n = 200)			
	n	Proportion Anti-HCV+, %	Prevalence OR	95% CI	n	Proportion Anti-HCV+, %	Prevalence OR	95% CI
Demographic factors								
Aged 18–24 y	230	32	Ref		69	51	Ref	
Aged 25–29 y	127	60	3.14	2.02, 4.89	131	52	1.05	0.58, 1.88
Lifetime events								
Never been in prison	305	39	Ref		101	44	Ref	
Ever been in prison[b]	52	60	2.31	1.28, 4.18	98	59	1.88	1.07, 3.29
Quasi network								
Never injected with someone known to have had hepatitis	263	35	Ref		185	51	Ref	
Ever injected with someone known to have had hepatitis[b]	78	59	2.67	1.60, 4.44	10	80	3.87	0.88, 17.00
Initiation of drug use								
Aged ≥18 y	188	40	Ref		151	47	Ref	
Aged <18 y	169	44	1.15	0.75, 1.75	49	65	2.12	1.09, 4.12
Drug use behaviors								
Duration of injection ≥3 y	147	22	Ref		86	33	Ref	
Duration of injection >3 y	210	56	4.35	2.74, 6.90	114	66	3.98	2.22, 7.14
Did not inject speedball past 6 mo	139	33	Ref		111	37	Ref	
Injected speedball past 6 mo	218	48	1.84	1.19, 2.86	89	70	3.92	2.18, 7.03
Did not inject cocaine past 6 mo	111	29	Ref		123	39	Ref	
Injected cocaine past 6 mo	246	48	2.23	1.41, 3.66	77	71	3.91	2.14, 7.12
Did not use syringe exchange past 6 mo	63	29	Ref		101	46	Ref	
Used syringe exchange past 6 mo	294	45	2.04	1.13, 3.66	99	58	1.62	0.93, 2.84
Not in drug treatment past 6 mo	244	34	Ref		81	54	Ref	
In drug treatment past 6 mo	113	60	2.98	1.90, 4.70	119	50	0.83	0.47, 1.46
Did not share cotton past 6 mo	179	39	Ref		127	43	Ref	
Shared cotton past 6 mo	178	46	1.33	0.87, 2.03	73	67	2.76	1.52, 5.01
Did not share cooker past 6 mo	144	37	Ref		121	45	Ref	
Shared cooker past 6 mo	213	46	1.44	0.93, 2.21	79	62	2.03	1.14, 3.61
Did not share rinse water past 6 mo	235	41	Ref		141	45	Ref	
Shared rinse water past 6 mo	122	43	1.09	0.70, 1.70	59	66	2.35	1.25, 4.39
Sexual behaviors past 6 mo								
Did not receive money for sex	318	41	Ref		173	49	Ref	
Received money for sex	39	54	1.71	0.88, 3.32	27	70	2.52	1.06, 5.94
Did not receive drugs for sex	336	40	Ref		182	50	Ref	
Received drugs for sex	21	67	2.94	1.20, 7.22	18	67	2.00	0.73, 5.48
Serologic tests								
Never infected with hepatitis B	276	33	Ref		122	42	Ref	
Evidence of infection with hepatitis B	81	73	5.45	3.24, 9.18	78	67	2.78	1.55, 5.00
Not infected with HIV	348	41	Ref		181	50	Ref	
HIV seropositive	9	78	5.02	1.19, 21.14	19	63	1.69	0.64, 4.47

Note. OR = odds ratio; CI = confidence interval.
[a]Only variables significant at either site are shown in the table. The following variables were not significantly associated with HCV infection: sex, race, homelessness, ever been raped, used crack, shared syringes, injected frequently, men who have sex with men, condom use.
[b]Excludes persons who answered unknown or refused to answer.

about migration patterns. In the Lower East Side, 77% had ever been homeless in the previous 6 months, and 41% were recruited in the summer. Most did not provide addresses or telephone numbers of relatives in New York City to permit recruiters to locate them for follow-up, and few (<25%) returned for 6-month follow-up.

In contrast, Harlem participants were more likely to be long-standing residents, given that fewer were homeless (41%), a larger proportion relied on public assistance (21%), and fewer were recruited in the summer (22%). Most (77%) provided the name of a friend or relative from the neighborhood to contact for follow-up, and more than half (65%) returned for the 6-month follow-up visit (although an additional 20% were in prison in New York at the time of 6-month follow-up).

Despite these demographic differences, we identified some factors associated with HCV infection that were similar between the 2 sites. These similar factors (i.e., number of years injecting, use of cocaine, and infection with HBV) have been described in the literature.[4,7–9] However, we did not find direct syringe sharing, which is an established risk factor for HCV infection among injection drug users,[8–11] to be associated with prevalent HCV infection. Nevertheless, several correlates of HCV infection in our sample may have served as markers for syringe sharing. Because we were conducting analysis on prevalent infections and because infection usually occurs early after initiation of injection drug use, we cannot determine whether self-reported syringe sharing in the past 6 months refers to an activity that occurred subsequent to onset of HCV infection.[4]

One of our more intriguing findings relates to the possibility of indirect transmission as a result of sharing paraphernalia. Indirect sharing (i.e., sharing cotton, cookers, rinse water) has not been proven to be associated with HCV infection; however, front loading (pouring drugs from 1 syringe into another) has been found to be associated with HCV infection among injection drug users who do not report direct sharing.[12] One recent report from

TABLE 3—Logistic Regression Models for Factors Associated With Hepatitis C Virus (HCV) Infection Among Young Injection Drug Users and Those Who Recently Initiated Injection Drug Use in New York City, by Site of Recruitment[a]

	Lower East Side (n = 357)		Harlem (n = 200)	
	Adjusted OR	95% CI	Adjusted OR	95% CI
Age at interview, y				
≤24 (reference)				
>24	2.27	1.33, 3.87	0.99	0.49, 1.99
Injected with someone known to have had hepatitis				
No (reference)				
Yes	2.59	1.42, 4.69	4.39	0.74, 26.06
No. of years injecting				
≤3 (reference)				
>3	3.89	2.28, 6.63	4.33	2.17, 8.65
In the past 6 mo				
Did not inject cocaine (reference)				
Injected cocaine	1.64	0.94, 2.83	3.08	1.53, 6.20
No drug treatment (reference)				
Drug treatment	2.79	1.61, 4.85	0.83	0.43, 1.61
Did not share cotton (reference)				
Shared cotton	1.33	0.81, 2.21	2.13	1.03, 4.42
Did not receive money for sex (reference)				
Received money for sex	0.89	0.36, 2.20	3.50	1.53, 9.67

Note. OR = odds ratio; CI = confidence interval.
[a]All variables significantly associated with HCV infection on bivariate analysis (shown in Table 2) were initially entered into the model. The final models shown include only those variables that remained significant, in at least 1 site, after backward elimination.

Washington State showed an association between sharing of other injection equipment and incident HCV infection (H. Hagan, PhD, oral communication, December 1999). In both sites, sharing cotton was positively associated with HCV infection, but the association was significant only in Harlem. Given the highly infectious nature of HCV, it is plausible that indirect sharing may lead to infection, but further research is needed.

A unique finding of this study was that certain factors associated with HCV differed between the samples. This was unexpected, because drug users traveled between the 2 areas, particularly to buy drugs when rumors indicated that prices were better in one of the neighborhoods. In the Lower East Side, older age and being in drug treatment in the prior 6 months were associated with HCV infection. Older age has been shown in other studies to be a risk factor for HCV,[4,10] but why it was not a risk factor for HCV in Harlem remains unclear. It is unlikely that drug treatment itself increases the risk of HCV[13]; rather, treatment may be a marker for higher-risk injectors (e.g., more frequent injection and cocaine use), which may actually explain our finding. We also found that in Harlem, receiving money for sex was associated with HCV. Multiple studies have reported that HCV is inefficiently transmitted sexually.[14–17] We cannot exclude the possibility that a more established risk factor (e.g., syringe sharing) or frequency of injection may be indirectly responsible for this association.

Few studies have examined the risk for HCV infection among young injection drug users or those who have recently initiated injection drug use. One study in Baltimore, Md, found that new injection drug users were more likely to contract HCV infection when the partner in direct syringe sharing was at least 5 years older, presumably because an older injection drug user is more likely to be infected.[8] That study also suggested that initiation before 19 years of age and a time lapse of 60 days between first having drugs injected and being able to inject oneself may be associated with HCV infection.[8] This latter finding suggests that frequent need to use helpers for injection increases the risk for HCV. However, we did not observe these associations with HCV infection among our 2 samples of young injection drug users in New York City. Nevertheless, consistent with the Baltimore study's finding that a network factor (sharing with an older partner) predicted HCV infection, we also found that a network factor (injecting with someone with hepatitis) was a risk factor, at least in the Lower East Side. Network characteristics have been associated with HIV infection among new injectors[18] and among drug injectors in general.[19]

We did observe differences in the prevalence of blood-borne pathogen infections between the samples from these neighborhoods. Although these differences may reflect behavioral differences, they might also be the result of a higher background prevalence of chronic infections in Harlem, which provide a larger reservoir from which transmission can occur. For example, in Harlem, the cumulative rate of AIDS is 29% higher than that in the Lower East Side (4000 per 100 000 in Harlem; 2841 per 100 000 in the Lower East Side).[20] In addition, in Harlem, chronic liver disease is a leading cause of excess morbidity and mortality; HCV infection in combination with alcohol abuse is the primary etiology of chronic liver disease in this community.[21]

Many of the Lower East Side participants may have come from areas with a low prevalence of HCV infection (e.g., suburbs, smaller cities). They could have had a lower chance of contracting HCV infection, because their risk behaviors may have occurred most often while they were in those low-prevalence areas. Although the average age was higher in the Harlem than in the Lower East Side participants, these results are insufficient to explain the observed differences, especially after duration of injection is accounted for. When we examined behaviors, we found that the use of syringe exchange was more common among participants recruited from the Lower East Side than among those recruited from Harlem, which might contribute to higher rates of blood-borne pathogen infection in Harlem.

Various published studies of HCV and injection drug use have shown prevalence rates of HCV infection approaching 65% to 90%, especially after the first several years of initiating injection.[4,8,10,11] At the 2 sites in our study, the HCV infection prevalence was lower than was reported in these studies, and we found a longer time of injecting (>6 years) before reaching a peak prevalence of infection. Additionally, our reported prevalence was lower than the prevalence reported in young injection drug users in Baltimore.[8] This may be the result of

a variety of factors, including decreased transmission resulting from HIV prevention activities (e.g., harm reduction, syringe exchange). Several studies have found declines in HIV infection rates and risky drug use behaviors among both newer and longer-term injection drug users in New York City during the 1990s.[22–26]

National surveillance data suggest that HCV infection incidence in injection drug users is declining throughout the United States.[2] Additionally, incidence rates for HCV can vary across the country. For example, in the late 1990s, Hagan et al. reported an HCV infection incidence in Seattle, Wash, of 20.9 per 100 person-years,[27] which is lower than that observed in Baltimore.[4]

Several study limitations should be acknowledged. First, because we did street recruitment, including peer referral, the extent to which our samples are representative of injection drug users elsewhere or even in the respective neighborhoods is unknown. We cannot exclude the possibility that we recruited biased samples of injection drug users; however, we attempted to minimize this possibility by mapping the communities and recruiting from various sites within the neighborhoods.

Second, because we asked persons to recall behaviors over a 6-month period, the information may reflect averaging of disparate patterns; therefore, the ability to disentangle distinct behaviors was limited. Although the quality of self-reports among injection drug users is a methodologic concern, most literature shows that self-reports are reasonably valid.[28,29] Additionally, the observed association between HCV infection and injecting with someone known to have had hepatitis provides additional construct validity for self-reported behaviors among our participants.

Third, we calculated prevalence odds ratios instead of prevalence ratios, which may have overestimated the magnitude of association of some factors with HCV infection. However, our primary aim was to determine whether an association existed, not to quantify the magnitude of the association, and also to allow for comparisons between bivariate and multivariate analyses (which can be done with prevalence odds ratios but not prevalence ratios). Finally, with analyses based on prevalent infection, we cannot determine with certainty whether reported behaviors reflect the period before or after onset of infection.

The most effective way to prevent HCV infection is not yet known. Important variations in patterns of HCV infection in different injection drug user populations suggest that prevention programs should adapt to local patterns. For example, within Washington State, syringe exchange was protective against HCV infection in Tacoma[30] but not in Seattle.[27] Whether this difference is a result of different operating characteristics of the syringe exchange programs remains to be determined. Similarly, our study, which also found no association between HCV prevalence and syringe exchange, showed that behaviors and risks for HCV infection among injection drug user populations in 2 different neighborhoods within the same city can vary.

Because of the differences observed in New York City, prevention programs in Harlem and the Lower East Side could consider different prevention strategies. In Harlem, for example, prevention programs could place more emphasis on persons who receive money for sex (e.g., supply information on and facilitate testing for HCV infection). In the Lower East Side, activities that link harm reduction with drug treatment programs and increased programs to reach transient young injectors (e.g., drop-in centers, providing HCV testing and information about HCV at syringe exchange sites) may be a better strategy. Because HCV infection occurs soon after initation of injection, programs to prevent HCV infection among injection drug users must focus on persons who recently initiated drug injection (those not already infected). Knowledge of the local HCV transmission patterns may help to target efforts to reduce transmission behaviors. □

Contributors

T. Diaz coordinated the study in Harlem, analyzed the data, and wrote the paper. D. C. Des Jarlais coordinated the study in the Lower East Side and assisted with data analysis and the writing of the paper. D. Vlahov assisted with data analysis and the writing of the paper. T. E. Perlis was responsible for the data management of the Lower East Side study and participated greatly in data analysis. V. Edwards was responsible for the field activities of the Harlem study and contributed to the interpretation and writing of the paper. S. R. Friedman was a coinvestigator of the Lower East Side study and assisted with data analysis and the writing of the paper. R. Rockwell was responsible for the field activities of the Lower East Side study and contributed to the interpretation and writing of the paper. D. Hoover was the statistician and was responsible for checking all data analyses and developing logistic regression models. I. T. Williams was coordinator of the hepatitis portion of the Collaborative Injection Drug User II (CIDUS II) study, was responsible for hepatitis testing and interpretation of hepatitis results, and assisted in writing the paper. E. R. Monterroso was coordinator of the CIDUS II study, contributed ideas for data analysis, and assisted in writing the paper.

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